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Comparison of Four Tests of Quadriceps Strength in L3 or L4 Radiculopathies

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Study Design. This prospective cohort study evaluated four office tests of quadriceps strength in symptomatic adults with radiographic evidence of L3 or L4 nerve root compression.

Objective. The study observed the performance of each test for its ability to detect quadriceps weakness when compared to the asymptomatic side. To determine the potential influence of radicular pain on the performance of the four tests, a control group of patients over the age of 40 with clinical and radiographic L5 or S1 radiculopathies underwent identical testing of quadriceps strength.

Summary of Background Data. The L3 and L4 nerve roots innervate the quadriceps; therefore, quadriceps weakness may be a consequence of L3 or L4 radiculopathies. There are no standardized or validated methods to evaluate quadriceps strength in the clinical office setting. This may lead to inconsistent detection by clinicians of quadriceps weakness in cases of L3 or L4 radiculopathy.

Methods. Thirty-three consecutive patients with L3 or L4 radiculopathies and 19 with L5 or S1 radiculopathies were studied. The four tests of quadriceps strength included: 1) single leg sit-to-stand test; 2) step-up test; 3) knee-flexed manual muscle testing; and 4) knee-extended manual muscle testing. Results from a second examiner repeating the four tests were used to calculate interrater reliability.

Results. In L3 and L4 radiculopathies, unilateral quadriceps weakness was detected by the single leg sit-to-stand test in 61%, by knee-flexed manual muscle testing in 42%, by step-up test in 27% and by knee-extended manual muscle testing in 9% of patients. The sit-to-stand test detected weakness in all but one case when weakness was detected by another test. All patients with L5 or S1 radiculopathies could perform the sit-to-stand test. Kappa coefficient was high for sit-to-stand test (0.85), step-up (0.83), and knee-flexed manual muscle testing (0.66), and low for knee-extended manual muscle testing (0.08).

Conclusion. In L3 and L4 radiculopathies, unilateral quadriceps weakness was best detected by a single leg sit-to-stand test. Patients of similar age with radicular pain caused by L5 or S1 radiculopathies could perform this test. As the interrater reliability of the single leg sit-to-stand test is high, clinicians should consider utilizing this test for assessing quadriceps strength in cases of L3 and L4 radiculopathies. [Key words: lumbar radiculopathy, quadriceps, physical examination, disc herniation]
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Midlumbar radiculopathies that affect the L3 or L4 nerve roots account for about 5% of cases of unilateral sciatica requiring surgery.[1,2] The frequency of all cases of L3 and L4 radiculopathies managed either surgically or conservatively is not reported, but is probably low as compared to radiculopathies affecting the L5 or S1 roots. It has been noted that midlumbar radiculopathies become more frequent with advancing age,[2,3] with the highest incidence occurring in the sixth decade.[1]

Symptoms associated with midlumbar radiculopathies include lower extremity pain radiating into the lateral hip, anterior surface of the thigh, and to the anterior knee.[1] Paresthesias of the anterior thigh, knee, and medial shin can also be present. Difficulty with knee extension during ambulation would be expected if midlumbar radiculopathies affect the motor function of the quadriceps, as the L3 and L4 nerve roots innervate these muscles. Unilateral quadriceps weakness would be most noticed with strenuous leg activities such as ascending/descending stairs or standing up from the sitting position, and, if severe, could result in knee buckling.

Physical signs associated with midlumbar radiculopathies have been documented. Unilateral impaired patella reflexes were reported in 35% of patients requiring surgery for disc herniations at L2–L3, 48% for L3–L4, and 6% for L4–L5 and L5–S1 combined.[2] Sensory deficits to pin prick involving the L3 or L4 dermatomes were noted in 39% of surgically treated patients with L2–L3 disc herniations, and in 30% of patients with problems at L3–L4.[1]

Weakness of the quadriceps was reported in only 1% of 1986 patients operated on for lumbar disc herniations at any lumbar level by Hakelius and Hindmarsh.[4] Aronson and Dunsmore reported a higher level of quadriceps weakness in patients with mid lumbar radiculopathies.[1] They noted that 30% of patients with L2–L3 disc herniations and 37% of patients with herniations at L3–L4 had impaired quadriceps strength.[1] Unfortunately, neither study described their method of evaluating quadriceps strength.

We are unaware of any validated methods for the office assessment of quadriceps strength in cases of lumbar radiculopathies. All of the standard texts of physical examination reviewed suggest utilizing manual muscle

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testing for evaluating quadriceps strength. Several suggest that the examiner ask the patient to straighten the flexed knee while the examiner offers resistance,[5,6] and others suggest that the patient maintain the knee in extension, while the examiner attempts to flex the knee.[7–10] As the quadriceps is a powerful antigravity muscle, detection of mild or even moderate weakness using manual muscle testing might be difficult. If manual muscle testing has low sensitivity for detecting weakness when it is present, this could lead to the false conclusion that quadriceps strength is normal, when impaired strength is actually present.

As the quadriceps are antigravity muscles, it seems appropriate to utilize the patient's own body weight as resistance during quadriceps strength testing. Liang and Katz suggested "quadriceps function can be evaluated by having the patient climb up and down from a chair, starting with a patient's stronger leg," although a detailed description of this test is not offered nor is its validity or reliability referenced.[11]

Reports on the reliability of tests of quadriceps strength in lumbar radiculopathies are limited to the study by McCombe *et al*.[12] They reported a high kappa agreement coefficient (0.80) for detection of quadriceps weakness between two physician examiners, but a very poor kappa (0.06) between physician and physical therapist. This suggests that differences in standards for defining weakness or in methods of testing existed between physical therapists and physician examiners. Unfortunately, they did not describe their methods for quadriceps strength testing.[12]

This study evaluated four methods of assessing quadriceps strength in patients with symptomatic L3 and L4 radiculopathies confirmed by diagnostic imaging. All four tests could be performed in a typical office setting. Included were two methods that utilized the examiners strength as resistance, knee-extended manual muscle testing (MMT), and knee-flexed MMT, and two methods that utilized the patient's body weight as resistance, step-up onto a footstool, and single leg sit-to-stand test. Each method was evaluated for the ability to detect weakness in the symptomatic *versus* asymptomatic quadriceps, along with interrater reliability. To determine the ability of patients to perform these tests while experiencing radicular pain from roots not innervating the quadriceps, the study also evaluated quadriceps strength in patients with L5 and S1 radiculopathies.

■ Methods

Inclusion Criteria—L3 and L4 Radiculopathies. Patients were recruited from a hospital spine center over an 8-month period if they had a symptomatic, unilateral lumbar radiculopathy, and a magnetic resonance imaging (MRI) or computed tomography (CT) documented spinal lesion that displaced or compressed the L3 or L4 nerve roots on the symptomatic side.

Symptoms of radiculopathy included unilateral leg pain involving the groin, thigh, or lower leg, paresthesias involving the thigh, knee, or lower leg, and/or symptoms suggestive of weakness in the affected extremity.

Inclusion Criteria—L5 and S1 Radiculopathies. During the same 8-month recruitment period, patients over the age of 40 presenting with unilateral lumbar radiculopathies with MRI or CT documented displacement or compression of the L5 or S1 nerve roots were asked to participate as control patients. The age of 40 or above was chosen in an attempt to match the expected age distribution of patients with L3 and L4 radiculopathies.[1]

Exclusion Criteria. Patients with radiculopathies were excluded if they had any of the following characteristics.

1. Bilateral radicular symptoms, as this would make it impossible to compare strength testing results with an asymptomatic side
2. Neurologic or muscular disease affecting lower extremity motor or sensory function
3. Presence of symptom magnification as defined by Waddel *et al*, as this may interfere with the accurate interpretation of strength[13]
4. Symptoms from hip or knee arthritis
5. Cancer under active treatment
6. Severe psychiatric disorders or cognitive dysfunction
7. Nonambulatory status for any reason
8. Absence of reading or writing skill of the English language that would prevent completion of paper and pencil measures

Evaluation of Patients. Patients with a lumbar radiculopathy who were interested in participating in this study, and willing to sign an informed consent, were asked to complete a brief questionnaire that inquired about specific symptoms suggestive of quadriceps weakness. This questionnaire was developed by modifying items that comprise the Lysholm score for evaluation of knee ligament injuries.[14] This included items inquiring about the presence and severity of limping, need for support when walking, problems with knee buckling with walking, difficulty climbing or descending stairs, and difficulties getting up from sitting. All other demographic and symptom information was extracted from the standard history and physical examination form utilized for all patients evaluated at the Spine Center. This form included a section for describing precise leg pain location, a 0 to 10 Visual Analogue Scale (VAS) for assessment of back and leg pain intensity anchored with No Pain (zero) and Severe Pain (10), and the Oswestry Low Back Pain Questionnaires for assessment of disability.[15]

The attending physician recorded the anatomic abnormality on MRI or CT that was felt to cause the radiculopathy. This included the spinal level where the abnormality was noted and the type of lesion that caused nerve root displacement or compression. Disc herniations within the spinal canal were coded as paracentral disc herniation, and disc herniations predominantly within or lateral to the neuroforamen were coded as lateral disc herniation. Nerve root compressions caused by stenosis of the spinal canal from a combination of facet degeneration, ligamentum flavum hypertrophy, and disc protrusions were coded as spinal stenosis, and nerve root compressions within the neural foramens resulting from degeneration, spondylolisthesis, or deformity were coded as foraminal stenosis.

The physician performed and documented a routine physical examination of the back and lower extremities including assessment of trunk range of motion, straight leg raising test, femoral stretch test, patella and Achilles reflexes, sensation to pin prick, and manual muscle strength testing. Strength testing

included strength of the ankle dorsiflexors, great toe extensors, and the ability to do unilateral heel raises.

In addition to the routine physical examination, four tests of quadriceps strength were performed as described. The asymptomatic leg was always tested first. Results were recorded in one of three categories: 1) normal in both legs; 2) impaired in the symptomatic leg only; or 3) impaired in both legs.

1. **Single leg sit-to-stand test** was performed with the patient sitting in a standard chair and the examiner standing facing the patient. The examiner asks the patient to fully extend one knee and to avoid contacting the ground with that foot during testing. The examiner held the patient's hands for aid with balance and asked the patient to rise up to the standing posture using only the strength of the remaining leg. Successfully rising to the standing posture was recorded as normal and unsuccessful as impaired.

2. **Step-up test** was performed with the patient standing facing the examiner, with a standard 7-inch step stool between the two. The examiner held the patient's hands for aid with balance and safety, and the patient was asked to step up onto the step stool. Successful step-up using the strength of the leg being tested was recorded as normal, and the inability to step up or excessive push off or jumping by the opposite leg was recorded as impaired.

3. **Knee-flexed MMT** was performed with the patient lying supine on the examination table. The examiner grasps the patient's distal leg above the ankle and flexed the patient's hip to approximately 90° while maximally flexing the knee. Using the examiners hand as resistance, the patient was asked to straighten the leg towards the end of the table. The ability to straighten the leg against maximum resistance was recorded as normal and the inability to do so as impaired.

4. **Knee-extended MMT** was performed with the patient lying on the examination table. The examiner grasps the patients' distal leg above the ankle with one hand and places his other forearm under the patient's distal femur, just proximal to the knee. The patient was asked to straighten the knee, which results in the heel rising off the table. The examiner then tries to bend the knee and touch the heel to the table as the patient offers maximum resistance. Ability to maintain the knee in extension was recorded as normal and allowing the heel to touch the table as impaired.

Reliability of Quadriceps Strength Testing. When a second examiner was available, the patients with both mid- and lower lumbar radiculopathies underwent a repeat of the four tests of quadriceps strength. The second examiner was informed as to the side of the patient's symptoms, but was blinded as to the findings of the first examiner and the level of the radiculopathy.

Follow-up of Patients. All patients were followed clinically until their signs and symptoms improved. Treatment recommendations were unaffected by study participation.

Statistical. The data were analyzed using SPSS for Windows 8.0 statistical software (SPSS Inc., Chicago, IL). Characteristics of patients were analyzed using frequency and means calculations. Findings on physical examination were summarized. The frequency of the detection of impaired quadriceps strength by each of the four tests was calculated for those patients with L3 and L4 radiculopathies. The frequency of quadriceps weakness in L5 and S1 radiculopathies was also calculated. As there exists no gold standard for the office detection of quadriceps weakness to which these four tests could be compared, true sensitivity and specificity statistics cannot be calculated.

Table 1. Characteristics of Patients With Lumbar Radiculopathies

	Involved Nerve Root			
	L3 (N = 10)	L4 (N = 23)	L5 (N = 8)	S1 (N = 11)
Age (yrs)	57	60	68	49
Symptom duration (mos)	2.2	3.1	3.3	2.3
Females (%)	30	57	50	55
VAS (0–10)				
Back	3.3	3.9	4.0	3.5
Leg	5.7	5.4	5.4	5.5
Oswestry (0–100)	37	32	37	39

VAS = Visual Analogue Scale.

Kappa values were calculated to determine the interrater reliability of the four tests of quadriceps strength.

To determine the number of patients required to compare the performance of the quadriceps strength tests between those with midlumbar radiculopathies *versus* the control group, a power analysis was performed. It was assumed that some quadriceps weakness would be present in 40% of the midlumbar radiculopathy group,[1] and less than 5% of the control group.[4] Using an alpha of 0.10 and a beta of 0.20, and performing calculation of sample size for comparing proportions of dichotomous variables, a sample size of 22 patients per group was found necessary for this study.[16]

Our hospital's Investigation Review Board approved this study.

■ Results

During the study period, 33 patients with L3 or L4 radiculopathies and 19 patients with L5 or S1 radiculopathies were recruited to undergo the tests of quadriceps strength. Demographic and clinical characteristics of study patients are presented in Table 1.

For the patients with midlumbar radiculopathies, 10 had L3 and 23 had L4 lumbar radiculopathies. For the group with lower lumbar radiculopathies, 19 patients were recruited, including 8 with L5 and 11 with S1 radiculopathies. Locations of radicular pain symptoms are presented in Table 2 for each anatomic region of the lower extremities.

Diagnostic imaging was available for all patients. Lumbar MRI scans were available for 51 patients and CT scan for one patient. The location and type of anatomic abnormality felt to be responsible for the radicular symptoms are presented in Table 3.

All but 2 of the 52 patients in this study could perform the sit-to-stand test, and all of the patients could perform the step-up test with at least the asymptomatic leg. Of the two patients unable to perform the sit-to-stand tests with either leg, one had unilateral quadriceps weakness detected by all other tests, and the other one had normal strength by all other tests.

The results of the four office tests of quadriceps strength are presented in Table 4. The single leg sit-to-

Table 2. Location and Frequency of Pain Symptoms by Regions of the Lower Extremities

	Involved Nerve Root [N (%)]			
	L3 (N = 10)	L4 (N = 23)	L5 (N = 8)	S1 (N = 11)
Thigh				
None	—	8 (35)	—	—
Groin	2 (20)	—	—	—
Anterior	6 (60)	6 (26)	—	—
Lateral	2 (20)	6 (26)	3 (38)	4 (36)
Posterior	—	3 (13)	5 (63)	7 (64)
Knee				
None	3 (30)	16 (70)	5 (63)	6 (55)
Anterior	7 (70)	7 (30)	—	—
Posterior	—	—	3 (37)	5 (46)
Calf				
None	8 (80)	10 (43)	1 (13)	1 (9)
Medial	—	—	—	—
Anterior	2 (20)	11 (48)	—	—
Lateral	—	2 (9)	6 (75)	4 (36)
Posterior	—	—	1 (13)	6 (55)
Foot/ankle				
None	10 (100)	18 (78)	3 (37)	7 (64)
Medial	—	1 (4)	—	—
Dorsum	—	4 (18)	4 (50)	—
Lateral	—	—	1 (13)	2 (18)
Heel/sole	—	—	—	2 (18)

— = data not available.

Table 3. Diagnostic Imaging Abnormalities Causing Radiculopathies

	Involved Nerve Root [(N) (%)]			
	L3 (N = 10)	L4 (N = 23)	L5 (N = 8)	S1 (N = 11)
Involved level				
L2–L3	3 (30)			
L3–L4	7 (70)	3 (30)		
L4–L5		20 (87)	3 (38)	
L5–S1			5 (62)	11 (100)
Type of problem				
Paracentral HNP	4 (40)	6 (26)	5 (62)	11 (100)
Lateral HNP	5 (50)	15 (65)	2 (25)	
Spinal stenosis			1 (13)	
Foraminal stenosis	1 (10)	2 (9)		

Paracentral HNP = lateralized herniated nucleus pulposus contacting nerve root within the spinal canal; lateral HNP = herniated nucleus pulposus contacting nerve root within or lateral to neural foramina.

stand test was positive for unilateral impairments in quadriceps strength in 20 of the 33 (61%) patients with L3 or L4 radiculopathies. Eight of these 20 patients had unilateral quadriceps weakness detected only by the sit-to-stand test. The sit-to-stand test was positive in all patients with unilateral weakness detected by step-up test or knee-straight MMT, and in all but one of the patients with weakness detected by knee-flexed MMT.

For the 19 control patients, only 2 had any positive test for quadriceps weakness as detected with knee-flexed MMT, 1 bilateral and 1 unilateral. Both patients performed all other tests of quadriceps strength including sit-to-stand test normally.

For the 53 patients, 39 had the tests of quadriceps strength repeated by a second examiner. The findings of the two examinations were compared for determining interrater reliability. These results are presented in Table 5.

The standard neurologic examination of patients with L3 radiculopathies revealed the following abnormalities. Quadriceps weakness was detected in 7 (70%), and weakness was not detected in any other muscle group. Six patients (60%) had sensory deficits involving the anterior thigh, medial knee, or medial ankle.

In the L4 radiculopathy patients, 13 (56%) had unilateral quadriceps weakness, 7 (30%) had weakness of ankle dorsiflexion, and 2 (9%) had weakness of EHL. Twelve patients (52%) had impaired sensation, with all involving the medial ankle. Femoral stretch sign was positive in 6 (60%) of the patients with L3 radiculopathies, and in 10 (43%) of patients with L4 radiculopathies.

Results of patella reflexes corresponded poorly with quadriceps weakness. For L3 radiculopathies, unilateral impaired patella reflex was noted in 6 patients (60%) and of these, 4 had quadriceps weakness. Of the four patients with normal patella reflexes, three had quadriceps weakness. Similar discrepancies were noted for the 23 patients with L4 radiculopathies. Fifteen patients (65%) had unilateral impaired patella reflex and of these, 5 had normal and 10 impaired quadriceps strength. Of the eight patients with normal patella reflexes, five had impaired quadriceps strength.

Analysis of the responses to the modified Lysholm questionnaire revealed that difficulties with ambulation (limping), use of support with walking, problems with knee buckling, difficulty with stairs, and problems getting up from sitting were reported with high and statistically similar frequency for patient with both mid- and lower lumbar radiculopathies. Only one response had predictive value for the detection of quadriceps weakness. All six patients reporting that stairs had to be climbed with a step-to gait (one step at a time) had positive sit-to-stand tests, and five of six had positive step-up tests. Knee-flexed MMT was positive in three of these patients, and knee-straight MMT in one.

Clinical outcomes for the patients with midlumbar radiculopathies were generally favorable. One patient (3%) underwent decompression surgery for unremitting leg pain and progressive quadriceps weakness. The remaining 32 patients received conservative management, consisting mainly of education and observation. To help control symptoms and improve function during the recovery period, 55% of patients received oral medications and 39% were referred to exercise-oriented physical therapy. Ten patients (32%) received spinal injections depending on the lesion thought to cause the radiculopathy symptoms, with 2 receiving epidural steroid injection for disc herniations within the spinal canal, 6 receiving selected nerve root blocks for foraminal disc herniations, and 2 receiving facet injections for degenerative foraminal stenosis. Between evaluation and discharge (mean 3 months), improvements were noted in

Table 4. Results of Four Office Tests of Quadriceps Strength in Patients With L3 or L4 *Versus* L5 or S1 Radiculopathies

	L3 or L4 Radiculopathies (N = 33)			L5 or S1 Radiculopathies (N = 19)		
	Normal N (%)	Impaired N (%)	Bilat N (%)	Normal N (%)	Impaired N (%)	Bilat N (%)
Sit-to-stand test	11 (33)	20 (61)	2 (6)	19 (100)	0	0
Step-up on stool	24 (73)	9 (27)	0	19 (100)	0	0
MMT						
Knee flexed	19 (58)	14 (42)	0	17 (90)	1 (5)	1 (5)
Knee straight	30 (91)	3 (9)	0	19 (100)	0	0

Bilat = bilaterally impaired; MMT = manual muscle testing.

back pain VAS scores (3.7 to 1.4, $t = 5.2$, $df = 32$, $P < 0.001$) and leg pain VAS scores (5.5 to 2.0, $t = 7.2$, $df = 32$, $P < 0.001$). For those 20 patients with unilateral quadriceps weakness from L3 and L4 radiculopathies, 58% had full resolution of that weakness at the time of discharge from care.

■ Discussion

In this sample of patients with L3 and L4 radiculopathies, clinically detectable weakness of the quadriceps was common, being detected in two-thirds of patients. This frequency of quadriceps weakness is much higher than the 30% to 37% reported by Aronson and Dunsmore (1963) and may reflect a clinical advantage for the detection of weakness utilizing the strength tests under study.[1]

Of the four office tests of quadriceps strength, the single leg sit-to-stand test was most frequently positive for unilateral quadriceps weakness. In cases of midlumbar radiculopathies, it detected all but one patient with impaired quadriceps strength noted by the remaining three tests. The single leg sit-to-stand test requires the patients to lift their entire body weight with one leg from a 90° knee-flexed position. From a purely mechanical point of view, this maximizes the flexion moment on the knee that the quadriceps must overcome to raise the person. Although most normal individuals can perform this test, this requires substantial quadriceps strength. The performance of the step-up test, which also uses the patient's weight as resistance, only requires about 45° of knee flexion, thereby producing less flexion moment on the knee, and therefore less force for the quadriceps to overcome. Predictably, this test detected weakness at a lower frequency as compared to the sit-to-stand test.

The sit-to-stand test was normal in all patients with L5 and S1 radiculopathies. As intensity of leg pain and complaints of difficulty with leg function were similar for the groups with mid- and lower lumbar radiculopathies, it is doubtful that positive sit-to-stand tests for those patients with midlumbar radiculopathies was merely a result of pain inhibition or patients' perception of leg malfunction.

Table 5. Interrater Reliability Results for the Four Tests of Quadriceps Strength (N = 39)

	Percent Agreement	Kappa Coefficient
Single leg sit-to-stand	92	0.85
Step-up on stool	95	0.83
Knee-flexed MMT	84	0.66
Knee-extended MMT	87	0.08

MMT = manual muscle testing.

For the two methods of MMT, it was observed that the knee-flexed method detected quadriceps weakness with much greater frequency than the knee-extended technique. This finding could be predicted because of the significant mechanical disadvantage of the quadriceps acting over the fully flexed *versus* extended knee.

As reliability tends to improve with objectiveness of observations,[12] it was predictable that high interrater reliability would be noted for the sit-to-stand and step-up tests where results were based on easily observed criterion. Modest reliability was noted for the knee-flexed MMT technique, suggesting that it is a useful clinical test. Reliability of knee-extended MMT was unacceptably low. This combined with its low ability to detect quadriceps weakness would suggest that knee-extended MMT should be abandoned as a test of quadriceps strength.

Of the 54 patients studied, only 2 (4%) could not perform the sit-to-stand test with either leg. In one of these two patients, unilateral quadriceps weakness was detected by the other tests of quadriceps strength. In clinical practice, when sit-to-stand test cannot be performed using either leg, it would be reasonable to use knee-flexed MMT or the step-up test to evaluate quadriceps strength.

Our results suggest that the presence of sciatica and pain with leg usage resulted in perception of weakness for knee extension activities regardless of the root involved. The one exception was utilizing a step-to gait for ascending and descending stairs. All patients with this complaint had detectable quadriceps weakness by sit-to-stand test. This complaint might be useful for alerting clinicians to the presence of impaired quadriceps strength.

Quantification of quadriceps strength using isokinetic or isoinertial exercise equipment could be considered as a method to validate quadriceps weakness as detected by these office tests. These resources were not available for this study, though they may have been useful for confirming these findings. Additionally, we chose not to per-

form electromyograph (EMG) studies of the lower extremities in these patients. This would have reflected a deviation from our routine care of these patients that we could not justify in terms of patient discomfort or additional medical expense.

Most of the patients with L4 radiculopathies reported in this study had L4 nerve root compression by spinal lesions at the L4–L5 level, by either proximally extensing disc herniations, or lesions within or lateral to the L4–L5 foramina. L4 radiculopathies occur at much lower frequency than the L5 radiculopathies associated with L4–L5 pathology,[1,2] but are important to recognize when they are present.

Quadriceps strength returned to normal in over half of the patients by the time of discharge from care, suggesting a neuropraxia of the nerve root causes temporary conduction block in many of these radiculopathies. This favorable clinical outcome reflects the natural history of lumbar radiculopathies.[17] Although most of these patients did received various methods of treatment aimed at controlling pain and maximizing function during recovery, we do not suggest that any of our treatments alter the ultimate outcome that patients would reach without medical interventions.

In summary, the single leg sit-to-stand test was useful for detecting unilateral quadriceps weakness in L3 and L4 radiculopathies and may be useful to clinicians responsible for the care of these patients.

■ Key Points

- L3 and L4 radiculopathies frequently affect quadriceps strength.
- Unilateral quadriceps weakness was most frequently detected by the single leg sit-to-stand test.
- Single leg sit-to-stand test had high interrater reliability.
- Patients could perform single leg sit-to-stand test with radicular pain caused by L5 and S1 radiculopathies.

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